Bacteriological and Cleaning Studies on the Mouthpieces of Musical Instruments

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The common drinking cup and hand towel are uncommon sights today in most public places in this country. Multiple usage of these items decreased as the potential health hazards of such objects were better understood. In the past, improperly cleaned eating utensils have been shown to harbor pathogenic organisms (Cumming *et al.*, 1920; Saelhof and Heinekamp, 1920; and Lyons, 1936), but satisfactory procedures have been developed for cleaning and sanitizing such utensils for either institutional or domestic use (Mallmann *et al.*, 1947; Flett and Guiteras, 1952; and Walter, 1955). Few individuals would consider storing used silverware until the next meal without cleaning, but this is a common practice among musicians using mouthpieces of wind instruments. In some schools several people play the same musical instrument and use the same mouthpiece. In other cases there have been reports of such accumulations in the shank of the mouthpiece that tones have been impaired and blowing has been difficult. Because of these conditions, several band directors requested information and suggestions regarding proper methods for cleaning and sanitizing mouthpieces.

In preliminary investigations, Ogg and Walter (1951) noted that musical instrument mouthpieces sometimes harbor thousands of microorganisms. They also found that the number of organisms could be reduced materially by hand brushing the mouthpieces in a commercial detergent and subsequently rinsing them in a sanitizer solution.

The present report concerns further studies regarding the number of microorganisms found in different types of mouthpieces, and a practical method for a group of musicians to clean and sanitize their wind instrument mouthpieces quickly by brushing them in a single solution.

Materials and Methods

Bacteriological studies. To determine the number of bacteria in the rim, bowl, or shank of a mouthpiece, alginate swabs were moistened prior to use in 4 ml of sterile phosphate solution, buffered at pH 7.2, contained in screw cap vials (Tiedeman *et al.*, 1948). After swabbing, the swabs were dissolved in the vials by the addition of 0.5 ml of an autoclaved 10 per cent solution of sodium hexametaphosphate (Calgon)[2] and subsequent agitation (Higgins, 1950). Serial dilutions were made where necessary and routine plating techniques were followed employing a standard plate count medium (M-PH medium-BBL).[3] Incubation was at 35 C for 48 hr and counts are reported as numbers of bacteria recovered per mouthpiece.

Cleaning and sanitizing methods. Various techniques common among musicians were tried in an effort to determine how effective they were in removing bacteria from a mouthpiece. The method finally employed utilized a stainless steel tank about 16 cm wide, 40 cm long, and 20 cm deep to which 12 L of tap water containing a commercial detergent-sanitizer of recommended strength was added. Different types and sizes of brushes, used for cleaning laboratory glassware, were inserted into rubber suction cups and pressed onto the bottom of the tank so that they were held stationary (figure 1). The most satisfactory brush which was small enough to clean the shank of a trumpet or French horn mouthpiece was a Fuller[4] nylon brush recommended for cleaning electric razors.

The cleaning and sanitizing operation was performed by moving the mouthpiece up and down over a suitable brush 15 to 30 times within a period of 30 to 60 sec. In some instances it was necessary to use one brush

[2] Calgon Incorporated, Pittsburgh, Pennsylvania.

[3] Baltimore Biological Laboratories, Baltimore, Maryland.

[4] Fuller Brush Co., Hartford, Connecticut.

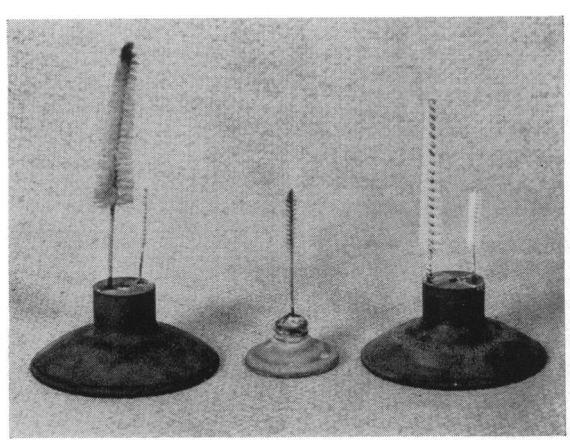

Figure 1. Different types of brushes for cleaning musical instrument mouthpieces cemented into rubber suction cups.

[1] Data contained in table 5 received as an addendum on January 6, 1959.

for the shank and another of greater diameter for the bowl and rim. Sometimes the mouthpiece was shaken to remove any excess liquid before playing or storing.

Results and Discussion

Preliminary studies were conducted in the laboratory by blowing a trumpet and a baritone mouthpiece for 1 min and then subjecting the mouthpieces, after each use, to different cleansing treatments such as hand or cloth wiping, or washing with tap water, detergents and/or sanitizers. Subsequently, the rim, bowl, and sometimes the shank were swabbed to determine numbers of bacteria remaining. The effectiveness of the different treatments is indicated in table 1. There appears to be some merit in the common practice of hand wiping, or wiping with a handkerchief or shirt-tail, a mouthpiece of another's instrument before playing. However, it became evident in other tests that organisms accumulated in the shank of the mouthpiece and were not removed by a casual wiping of the rim. On the other hand, brushing plus a detergent or a sanitizer or a combination of the two chemicals gave results worthy of further study.

On another occasion, a saxophone, trumpet, and trombone were brought to the laboratory and played. Bacteriological tests were made at intervals. The results varied somewhat, but those for the saxophone are representative and are presented in table 2. It is evident that large numbers of bacteria deposited in a mouthpiece may survive for 48 hr. The findings on the other two mouthpieces also indicated the effectiveness of dipping or brushing the mouthpieces in the detergent-sanitizer solution.

On another occasion, a field test was conducted by swabbing the rim, bowl, and shank of mouthpieces just prior to their use in a city band concert. All of the instruments involved had not been removed from their cases since the rehearsal the previous evening. The findings in table 3 indicate the survival and the variations in numbers of organisms that may be obtained among different sized mouthpieces and even on the same type used by different individuals.

Other laboratory and field tests clearly indicated that large numbers of bacteria could survive for several days in a metal or plastic mouthpiece. In addition, it was found that a cleaning treatment was effective in reducing the number of organisms. At this point it appeared evident that there was a need for a method to clean mouthpieces, especially multiple-use ones, that was practical and convenient for use in music departments.

The tank, stationary brushes, and detergent-sanitizer solutions mentioned previously were placed in the Bozeman High School and the Montana State College band rehearsal rooms along with instructions for washing mouthpieces. At intervals, over a period of 4 months, bacteriological tests were made on different mouthpieces. Most of the students were extremely interested in this project especially when they were kept informed regarding the findings. Since many of them washed their mouthpieces after each rehearsal,

TABLE 1

Numbers of bacteria obtained by swabbing the rim and bowl of a trumpet and baritone mouthpiece blown for 1 min and treated in different ways after each use

Treatment	Numbers of Bacteria	
	Trumpet	Baritone
Untreated, dry swab	1,200	51,000
Untreated, moist swab	7,900	95,000
Untreated but shank also swabbed	79,000	96,000
Rim wiped twice with hand	2,500	70,000
Rim and bowl wiped twice with thumb	200	1,200
Rim and bowl wiped twice with shirt-tail	690	580
Rinsed 10 sec with tap water (5 C)	120	3,800
Rinsed and brushed 10 sec with tap water (5 C)	38	160
Brushed 10 sec with Triton X-100 (16 C) and rinsed 2 sec under tap water	13	270
Brushed 10 sec with Hyamine 2389 (16 C) and rinsed 2 sec under tap water	6	9
Brushed 10 sec with Triton and Hyamine and rinsed 2 sec under tap water	11	35

TABLE 2

Numbers of bacteria obtained by swabbing a saxophone mouthpiece after different treatments

Treatment	Numbers of Bacteria
Not used for 2 days. Reed and inside mouthpiece swabbed	400,000
Saxophone played, and swabbed as above	2,000,000
Saxophone played, mouthpiece only brushed with detergent-sanitizer (Triton-Hyamine) solution	570
Saxophone played, mouthpiece only dipped in detergent-sanitizer 10 times	80

TABLE 3

Numbers of bacteria obtained from different types of mouthpieces stored in instrument cases for 24 hr

Instrument	Numbers of Bacteria
French horn	>400,000
Trumpet	>400,000
Trumpet	8,800
Trombone	>400,000
Trombone	2,400
Baritone	>400,000
Baritone	37,000
Baritone	28,000
Bass	20,000
Bass	110

the results on the college instruments presented in table 4 are of interest. The number of bacteria found in mouthpieces, which had been stored for various periods before playing, were invariably high the first few times tested, but thereafter were usually much lower. This might be expected as the brushing removed accumulated material especially in the shank and the residual sanitizer was more effective during the storage interval until the instrument was used again. It is difficult to explain why millions of organisms are found on some mouthpieces whereas only a few hundred are encountered on others after the instruments have been played. It is possible that some individuals have fewer organisms in their saliva. Burnett and Scherp (1957) have reported that the normal ingredients of secreted saliva may either depress or stimulate the growth of microorganisms. In addition, the pH of saliva is believed to exert an important influence on the oral microbial flora especially if it becomes too acid or alkaline. On the other hand, the silver plating on most mouthpieces may be toxic to some microorganisms. Burrows and Hemmens (1943) concluded that the silver communion cup was not an important vector of infectious disease because of the silver, the wine, and the practice of wiping the chalice after each use with a sterile linen cloth. Goetz *et al.* (1942) studied the self

TABLE 4

Numbers of bacteria obtained by swabbing Montana State College band instrument mouthpieces

Date	Instrument	Numbers of Bacteria		
		Before playing	After playing	After cleaning*
February 25, 1957	Trumpet	940,000	25,000,000	180,000
	Trumpet	9,100,000	27,000	1,100
	Trombone	120	400	920
	Trombone	46,000,000	380,000,000	13,000
	Bass horn	1,300,000	14,000,000	8,200
March 4	Trumpet	11,000,000	130,000,000	4,800
	Trombone	—	220,000,000	2,700
	Bass horn	—	33,000,000	120
	Baritone	8,400,000	44,000,000	3,200
	Baritone	680	1,600	400
	French horn	—	130,000	1,900
April 15	Trumpet	54,000	—	3,200
	Trumpet	—	—	240
	Trombone	—	—	960
	Trombone	—	—	120
	Bass	12,000	—	320
	Bass	—	—	280
	Bass	—	—	80
	Baritone	4,200,000†	—	80
	Baritone	—	—	120
	French horn	88,000	—	1,100
	French horn	800	—	80
April 22	Trumpet	400	—	32
	Trumpet	12,000	—	290
	Trombone	—	—	8
	Trombone	—	—	12
	Bass	—	—	280
	Bass	—	—	20
	Bass	12,000	—	8
	Baritone	—	—	64
	Baritone	—	—	16
	French horn	—	—	24
	French horn	—	—	4

* Iosan employed as a detergent-sanitizer.

† Mouthpiece had not been subjected to cleaning treatment previous to this test.

TABLE 5

Number of bacteria per mouthpiece found by swabbing after washing in a detergent-sanitizer solution

Date	Instrument and Solution	Standard Plate Count	Wash Solution	
			Color	pH
November 10, 1958	French horn	28		
	Trumpet	28		
	Trumpet	12		
	Trombone	24		
	Wash solution	<1	Brown	2.7
November 12	Tuba (unwashed)	46,000		
	Trumpet	60		
	Trombone	56		
	French horn	80		
	Wash solution	<1	Light brown	2.9
November 18	French horn (unwashed)	300,000		
	French horn	300,000		
	Trumpet	20,000		
	Trombone	300,000		
	Wash solution	27	Nearly colorless	3.1
November 24	Trumpet	>4 × 10⁶		
	Trumpet	>4 × 10⁶		
	Trombone	>4 × 10⁶		
	Trombone	>4 × 10⁶		
	Tuba	>4 × 10⁶		
	French horn	>4 × 10⁶		
	French horn	>4 × 10⁶		
	Wash solution	20	Colorless	3.4
	Detergent-sanitizer wash solution changed			
December 4	Trumpet	<1		
	French horn	20		
	Tuba	16		
	Trombone	4		
	Wash solution	<1	Brown	2.6
December 8	Trumpet	60		
	Trumpet	80		
	French horn	80		
	Trombone	12		
	Wash solution	<1	Light brown	2.9
December 11	French horn	80,000		
	Trumpet	28,000		
	Trumpet	28,000		
	Trombone	16,000		
	Wash solution	3	Nearly colorless	3.0

sterilizing surfaces of silver-containing plastics and reported that such surfaces became sterile within 1 min after swabbing with a suspension of *Escherichia coli* containing 100,000,000 cells per ml. They attributed the activity entirely to the metal. No effort was made in the present study to determine the reasons for the differences in counts obtained.

From the data presented in table, 4 it is evident that large numbers of bacteria are deposited in a mouthpiece while a wind instrument is being played. If the instrument is used by another player, a situation analogous to the common drinking cup exists. On the other hand, a cleaning procedure effectively reduces the number of bacteria to a point where there is little danger of disease transmission. In addition, a clean mouthpiece does not have an unpleasant odor or tend to become plugged.

In this series of tests (table 4) Iosan,[4] a detergent-sanitizer containing an organic iodine complex, was used but it seems likely that most reputable cleaners and sanitizers could be employed satisfactorily. The present study also included the use of a nonionic detergent (Triton X-100)[5] and a sanitizer (Hyamine 2389)[6] each employed separately and in combination at recommended strenths, a quaternary ammonium compound (Roccal),[6] and an iodine germicide (Iobac).[4] Satisfactory cleaning and low bacterial counts were obtained with all especially when used in combination with a thorough brushing. Some preference was expressed by band directors for the iodine solutions since disappearance of the yellow color indicated the necessity for changing the solution or adding more detergent-sanitizer without having to run any type of a test. Data supporting the procedure are shown in table 5. Since the iodine is volatile it was found necessary at the college to cover the tank when not in use in order to prevent discoloration of bass horns stored on shelves above. Otherwise no undesirable staining was encountered in using the iodine compounds. Similar experiences have been reported by users of these products in the food and dairy industries.

From the results reported, it is evident that, when mouthpieces are brushed in a detergent-sanitizer solution, many organisms are mechanically removed or killed. Bacteriological tests made on the Iosan solution at intervals, until the yellow color disappeared (after 5 to 7 days), indicated that the number of organisms present was always less than 10 per ml. This is undoubtedly the result of the low pH (about 3.5 in the use dilution) brought about by the phosphoric acid in the product, as well as the iodine in combination with nonionic synthetic detergents.

[4] Lazarus Laboratories, Inc., Division of West Disinfecting Co., Buffalo, New York.

[5] Rohm and Haas Company, Philadelphia, Pennsylvania.

[6] Sterwin Chemicals Inc., New York, New York.

Since the iodine concentration was adequate to prevent contamination of the detergent-sanitizer solution under the conditions of use in these tests, it was only necessary to change the solution at weekly intervals. This period would vary with the frequency and number of people using the solution.

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Summary

Musical instrument mouthpieces harbor thousands of bacteria which survive for several days. These organisms may be a potential hazard in the spread of disease when the instrument is used by several players as is common in some schools. In addition, uncleaned mouthpieces develop unpleasant odors and become difficult to blow.

A cleaning method in which mouthpieces were brushed 15 times within 30 sec in a commercial detergent-sanitizer solution greatly reduced the numbers of bacteria recovered by a swabbing technique. This cleaning procedure provided a sanitary mouthpiece as well as preventing accumulation of organic material in the shank.

High school and college band members were cooperative in using this method over an extended period. The band directors preferred detergent-sanitizers containing iodine since the sanitizing effectiveness was maintained as long as color was present, thereby eliminating the necessity for some test of concentration. However, other commercial products were also effective.

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